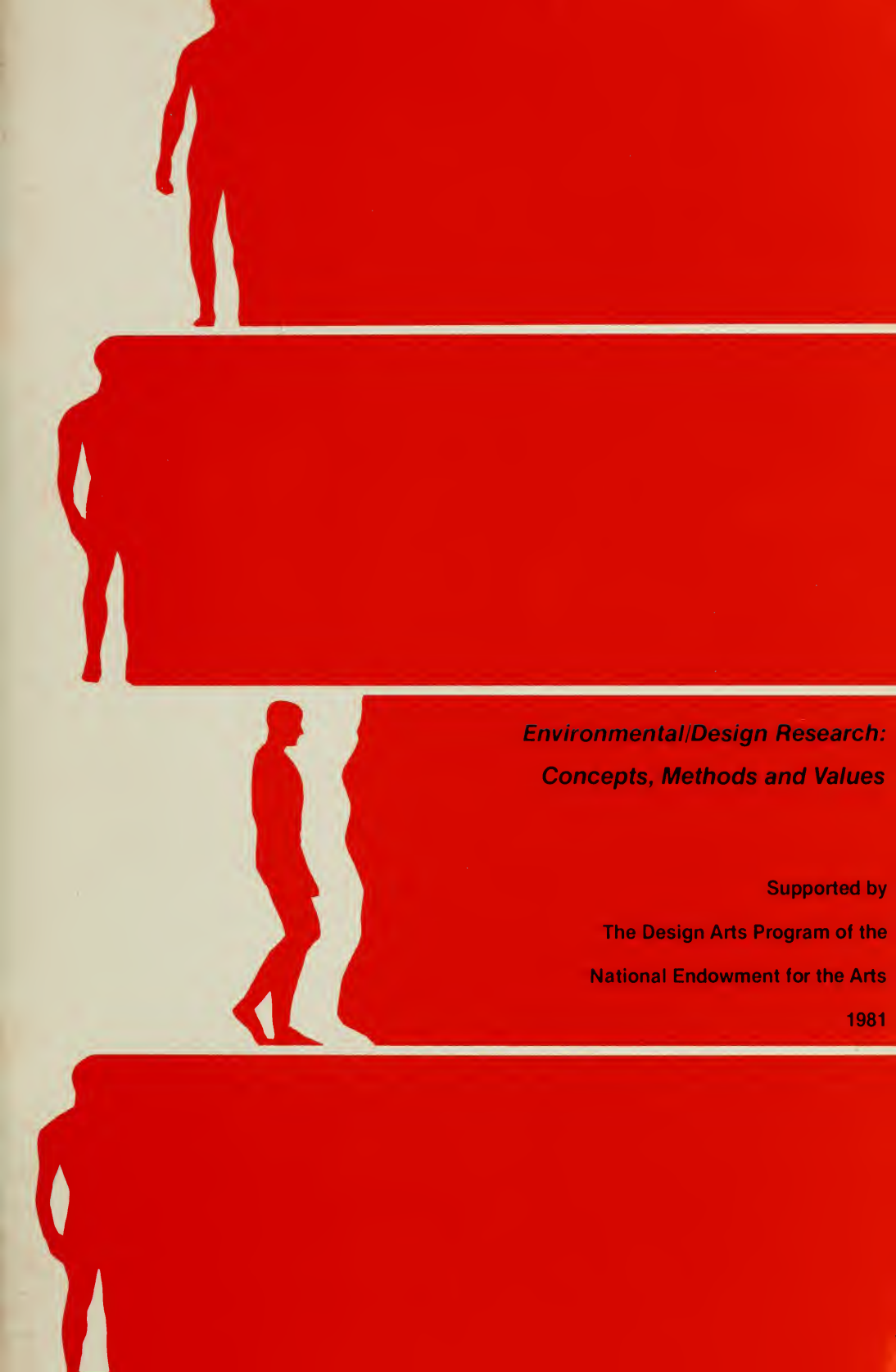

Environmental/Design Research:

Concepts, Methods and Values

Supported by

The Design Arts Program of the

National Endowment for the Arts

1981

Environmental Design Research *Concepts, Methods and Values*

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Foreword

This paper is a modest attempt to describe the confluence of concepts, methods and values that define what environmental/design research is and what environmental research does. It is written for those doing environmental/design research, or interested in doing it or in using its results.

The purpose of the paper is to provide a useful reference, or framework, for describing environmental/design research. It should provoke discussion and thought, whether in agreement or disagreement, and become useful to those formulating their own viewpoints, concepts and arguments. Environmental/design research is an emergent discipline, youthful enough to warrant continued discussion of its characteristics while nonetheless achieving results.

It is not the intent of this paper to justify environmental/design research, although the paper does contain some examples of such arguments, nor is its purpose to sell or promote environmental/design research as a field. We do hope to make some of its characteristics and concerns more understandable, to recognize commonality in its diversity, and thus to facilitate its communication.

The paper represents the personal opinions of its authors and is not to be construed as the policy of its sponsors. In writing the paper, however, the authors have received the support, comments and reviews of many people, some of whom consider themselves environmental/design researchers, as well as architects, environmental psychologists, anthropologists, landscape architects, industrial designers, engineers, historians, and public and private administrators.

The following individuals in particular have contributed to this work and deserve acknowledgement that some of their views and concerns are included in the paper. We recognize that not all will agree with our conclusions, but a clear and focused argument is itself valuable.

First, we would like to thank Michael Pittas, Director of the Design Arts Program of the National Endowment for the Arts, who supported the development of this paper and the Belmont Research Retreat, which provided its initial impetus, and Frederick Krimgold, of the National Science Foundation, who co-sponsored the Belmont Research Retreat.

Besides the authors, participants at the Belmont Research Retreat contributed to this paper by comment and review. They include: Robert Bechtel, Lynn Beedle, Richard Bender, John Bennett, Niels Diffrient, Leonard Duhl, John Eberhard, Charles Eastman, John B. Jackson, Ralph Knowles, Gary Moore, Constance Perin, and Raymond Studer.

Federal observers at the Belmont Research Retreat, many of whom also reviewed draft copies of this paper, included John Cable (Department of Energy), Harold Cannon (National Endowment for the Humanities), David Dibner (General Services Administration), Robert Dillon (National Institute for Building Science), Andrew Euston (Department of Housing and Urban Development), Robert Shibley (then of the Department of Defense and now the Department of Energy), Francis Ventre (National Bureau of Standards), and Richard Wakefield (National Institute of Mental Health).

Others offering valuable comments have included Mort Karp, Richard Krauss, Jeanne McFarland, Charles Masterson, Michael Murtha, Joseph Ouye, and Bernard Spring.

Other papers have been written in attempts to clarify and define what environmental/design research is and does; few have received such broad support. We hope the results will take arguments to the next level.

1

Environmental/Design Research: Concepts, Methods and Values

Environmental/design research is defined by a confluence of concepts, methods and values appropriate to complex problem-solving. Its major concern is the relationship between people and the designed environment, and its implications for the quality of life.

Its scope is broad, drawing from the concepts and methods of both science and art, including the physical sciences, social sciences, arts, and humanities. And its solutions are more diverse than those of a simple discipline. If you take a problem to an architect, a building will result; if you take a problem to a lawyer, action within a legal framework will result. The selection of the discipline itself is implicitly the selection of a problem's solution. But environmental/design research does not assume a solution. It examines a problem without a fixed solution bias, welcoming diversity and human or environmental complexity, and offers the potential of both interdisciplinary investigation and interdisciplinary results. Its products range from methods, policies and processes to physical design.

Environmental/design research, however, does have a preferred area of solution, one in which the design of, use of, and policies about the designed environment are seen as important determinants of the quality of life. The scale of concern is for that which is both designed and

natural, and ranges from a household product to a whole region, with cities, spaces and buildings somewhere in the middle. A critical concept for definition of environmental/design research is: If the research does not include exploration of needs from, perceptions of, or behavioral or emotional responses to environmental form and phenomena, it is not environmental/design research.

The twin goals of environmental/design research are to: (1) develop useful information to improve the fit between the designed environment and people's performance, satisfaction and well-being and (2) make the processes of planning, design, building, management, and use of designed environments into a "learning system" by addition of a systematic in-use evaluation component. Environmental/design research is not a new, or separate discipline, but a method of seeing and a method for transforming the processes of existing disciplines into ones more responsive to the unique issues associated with each designed environmental concern.

Because environmental/design research always reassesses the "problem-as-given," it develops problem statements that do not automatically generate one type of solution, and that are without bias towards a single discipline's normal repertoire of solutions.

As noted earlier, many disciplines assume problem methods and solutions, but many problems in our society are recurrent precisely because they cannot be solved along specific disciplinary lines.

The problems remain unsolved, frequently because they fail to attain "legitimate" status within a single discipline. Such problems have often been described as "wicked problems" because they defy single-disciplinary solution and are not "well-behaved."

This non-disciplinary definition of problems, where solutions are developed that fit the problem (and not the

discipline), demands multi- or interdisciplinary exploration. This, in turn, brings an extensive repertoire of methods into play, from what we may call hard science, soft science, and the design, planning and engineering disciplines themselves.

Many methods may be used in approaching a problem, and they often have different values and assumptions underlying them. Environmental/design research affects designed and used environments, which in turn affect how people use, inhabit, or are exposed to them. As an endeavor of many disciplines, with a wide range of values, its value base is not as easily known or categorized as those of so-called normative disciplines. It is also a relatively youthful discipline, without a single, accepted theoretical basis. Because of these qualities, environmental/design research should make its operating values and assumptions as explicit as possible for each project, so that those who receive its products and act upon them can know the context of their development and assess the range of cases in which the work may be applicable.

These values and assumptions frequently emphasize a concern for the environment's primary users and reflect their objectives, for appropriate solutions are always defined in terms of augmenting human performance, satisfaction, and well-being, and attempt to be independent of disciplinary, institutional or procedural constraints. These values, in themselves, generate research and development activity into the removal of, or relief from, such constraints.

Developing appropriate solutions independent of such constraints allows a wide range of solutions to be seen as legitimate outcomes of environmental/design research. It means that the rescheduling of people's space-related activities is as legitimate as designing a building prototype, and that the development of policy, legislation or preparation of testimony is as legitimate as evaluation of furniture in use, or the development of new criteria for the generation of physical form. But environmental/design research always starts with a problem linked to environmental or design concerns. It may end with solutions that affect physical form, as well as ones that manage or alter how people use that form without physical alteration.

Whenever design is done poorly, when intended purposes are not met and/or new problems are created, we incur human and/or economic costs. Some of these are attributable to trying to solve the wrong problem, others to poor solutions to the right problem, and still others to the unintended consequences of design, design policy, and their use.

Some costs are very obvious, such as a set of outdoor steps in a public place that are badly proportioned and poorly lit, which becomes the target of several costly accident lawsuits. Some costs are less obvious, such as the poorly balanced power tools that fatigue the hand and arm, requiring frequent rest periods, or the poorly planned hospital that forces its highly-paid medical staff to walk excessive distances, using time and energy non-productively. These are not so obvious but, once understood, are calculable.

Other costs generated by poor design are not obvious or easily calculable, but are very real to those who bear them. The elderly frequently avoid certain activities because they are risky. They may avoid using public transit in winter because the bus stops don't protect them from the wind, or they may avoid shopping centers because the parking lots make them feel vulnerable to assault and theft. This avoidance of risk by the elderly denies them activities that can enhance the quality of their lives; it is a cost they must pay.

Some of these problems may not seem costly or catastrophic. But the frequency of their occurrence, and the fact that designed environments, products and processes are pervasive in our lives results in high aggregate costs. For example, accidents in homes alone, involving only a half-dozen architectural elements, cost the nation approximately $3 billion each year, not including the pain and suffering of the injured. Both the

hard-dollar costs and the personal pain and suffering costs reduce the quality of life.

Some costs can never be calculated, nor made dramatic, although their influence may be great. The aesthetic bleakness and inappropriate functioning, physically and psycho-socially, of most housing occupied by the poor is incalculable, but surely significant.

It can be made clear, then, that there are real costs to environments and products that either do not achieve their primary purposes or that create unanticipated problems. The cost argument, both human and economic, points to a positive public value of environmental/design research. The following illustrations augment this point in greater detail.

2

Office Exemplar

A number of economic analyses have been made of hospitals, offices and housing that strongly indicate that the costs generated by the "misfit" are far greater than costs of more appropriate and supportive design.

A current, major, environmental/design research study of human performance in office buildings, coupled with work done in the 1960's by the National Bureau of Standards, describes the relationships between office environments and human performance in the following ways.

The office building, its subsystems, furnishings and equipment are the environment in which office work is accomplished as part of a larger system whose goal is the accomplishment of a mission. (The mission of this system is probably something like "adding value to information within a managed decision system. This larger system includes operating energy, rules, information, social structures, management, maintenance of all systems and people, as well as the building, furnishings and equipment. The combined costs of all of these is the total cost of achieving the mission.

The ratio of people costs to building-related costs is about 14:1 over a 25-year period. More precisely, the physical environment accounts for 2.8 percent of the cost, and operation and maintenance for 3.6 percent, while people's salaries account for 93.6 percent of the

mission costs. Given these ratios, it becomes clear that to the degree that office environments affect the worker's job satisfaction and performance, supportive environmental design may have strong multiplier effects.

The following table shows how the three basic mission costs for the office over one, ten and 25-year periods can be calculated in relation to the total cost of doing work.

Percentages of Total Cost of Achieving the Mission of the Office

(calculated in constant $)

Mission Cost Component	Times Frames for Costs in Years		
	1 year	10 years	25 years
1. Construction, furnishings & equipment	38.1%	5.8%	2.8%
2. Operations & maintenance	2.2%	3.4%	3.6%
3. Office workers' salaries	59.7%	90.8%	93.6%

Assumptions for the table include the following:

— Space per worker: 165 sq. ft., including support space. Source: BOMA 1976-79 reports and Canadian Department of Public Worlds National Survey

— Construction cost: $50/sq. ft., National average January 1980.

— Furnishings: $1,500/worker, estimated; complete replacement after 10 years.

— Energy costs: $1.02/sq. ft., increasing at 15%/year.

— Maintenance and operating costs (excluding energy): $2.53/sq. ft., increasing at 8%/year. Source: BOMA.

— Salaries: Assume engineering technician, grade 4 at $15,221.

Given these large ratios of 30:1 between people and capital costs, it is clear that if there is even a slight causal relationship between the design of office environments and the productivity of office workers and managers, the economics of appropriate and supportive design are very attractive. Numerous studies have, in fact, shown that worker satisfaction with the work environment is always a component of overall job satisfaction and job

involvement, which are directly linked to turnover, absenteeism and grievance actions, which, in turn, affect the productivity of an organization. Recent environmental/design research has found that job performance itself is related to certain environmental qualities, such as privacy, lighting, and furniture performance. This same research also finds useful and surprising patterns in phenomena such as flexibility in the office, where it appears that 75 percent of the people don't change locations in the office at all, while 25 percent of them do, moving four times a year. Because these moves are not easy to make, job satisfaction is lower than for the non-movers. These findings become more important when viewed against the overall level of productivity in the office workplace, now at its lowest ever.

Most traditional efforts to halt lagging productivity have placed environmental change low on the list of priorities and have instead emphasized job redesign, flextime, industrial democracy, new management styles, and the introduction of new communications equipment. Each of these is an important factor and each has environmental implications, although these are seldom recognized. Environmental/design research broadens the range of issues and the range of solutions to accomodate these and other factors.

There are still questions to be explored about the design of the office workplace, whose answers will strongly augment what is now known and hence the range of potential treatments. Some of these researchable questions are:

- How important is privacy to the conduct of office work? And does having privacy reduce opportunities for interaction and communication?
- How can workers and managers be helped to understand that their environment is a manipulable tool and not just a place where tools are used?
- In offices, what do "knowledge workers" do that can be measured? What instruments could measure productivity of professionals, executives and administrators?
- What specific aspects of physical environment most increase or decrease productivity and job satisfaction?

- How should research results be organized as specific guidelines to direct workplace design, management, and policy?
- How can programming and design tools be developed that use research and aid the planning and design of workplaces?
- How do you provide for the development and testing of alternative designs and design concepts for office buildings, interior systems, furnishings, equipment and the management of these?

The office exemplar is, of course, only one kind of researchable issue appropriate to environmental/design research, and of demonstrable public value.

There are many other types of environments, users and issues, involving numerous design processes, policies and evaluation procedures, which are candidates for environmental/design research because they pose critical problems, obvious misfits, or a clear capacity to reduce the quality of life.

For some of these, basic research is needed to define critical issues and resources, such as the relationships between the built and natural environment; others benefit from applied research, with its focus on solving specific problems. In some cases, the methods and criteria for research are themselves the topics of research, as are inquiries into the nature of the design process or the development of intervention strategies on behalf of innovation. The development or discovery of knowledge, the advancement of the state of the art, and the definition, as well as the resolution, of issues are all within the purview of environmental/design research.

3

Environmental/Design Research Methods

As discussed earlier, the common subjects of environmental/design research are the reciprocal relationships between people, the environment, the process by which the environment is designed, made, used, and maintained. It also concerns the implications of these relationships for the quality of life. In order to accomplish its objectives, design research borrows, develops, adjusts and uses any methods that "work" to support a systematic approach to complex problem-solving. The nature of design research problems is such that the more complex, or "wicked," the problem, the less appropriate are available methods. In this sense, environmental/design research must be experimental in its methodological aspects.

Environmental/design research uses traditional methods of scientific research, but is not wholly defined by them. It uses precision, analysis and quantification where appropriate, but uses qualitative methods as well. It strives for accuracy, even where precision is not possible in the problem statement, research methods or results. It is as concerned with what is measured as it is with how exactly; in this sense, the term "accuracy" takes on qualitative meaning, while precision remains quantitative. For environmental/design research, accuracy is critical to the results, even where levels of precision may vary in the process, usually as a result of its real-world arena.

Environmental/design research must be internally consistent, as is science. And, if another researcher were given the same information, assumptions, and value set, the results should be replicable.

But the traditional hypothesis-testing approach to research may be inadequate because the act of design needs answers to so many hypotheses at the same time that the traditional methods would take inordinately long and it is unlikely that they could be applied evenly. Therefore, more holistic methods and more interdisciplinary methods must be developed to test these multitudes of hypotheses. This development of methods for environmental/design research is an important exploration in its own right.

Environmental/design research nonetheless shares significant parts of the same paradigm with science. It may have and often does have tests for reliability, replicability, validity, and sensitivity.

Similarly to design, environmental/design research deals with sets of problems that lie in the realm of direct experience; it has a sensory base and an intimate connection to the quality of life. Yet it can be distinguished from design and the distinction is critical for those proposing, doing, using or assessing research. The distinctions can also lead to their eventual unity, where the design process encompasses the learning and evaluative components of research over time.

Environmental/design research can usually be distinguished from design practice in a number of significant ways. Design is unique; its products are singular; and its methods are less important than its results. Design is product-oriented; it is justified as the solution to a problem, and the problem-solving method need not be replicated for evaluation. Design practice frequently welcomes intuitive leaps as it seeks to resolve the complexities of program and context into a single form. Its values are implicit in its product and its evaluation is qualitative, as well as quantitative.

Environmental/design research, on the other hand, is concerned with the frameworks for all the activities that affect design, allowing evaluation and design to take place within a rational context. Research is process- as well as product-oriented. The process must be replicable and its methods documented as a basis for evaluation of each research project's internal validity. Research takes a specialized view of the world in order to push at limits and to reach new levels of understanding. It is, in that sense, exclusive, rather than inclusive, by nature. And, while intuitive leaps used to create knowledge are an accepted or even preferred method in design, in research, intuition must be tested for its utility against specific research objectives. Environmental/design research is not singular, but concerned with sets of cases and generic application; it must be generalizable to more than a unique situation.

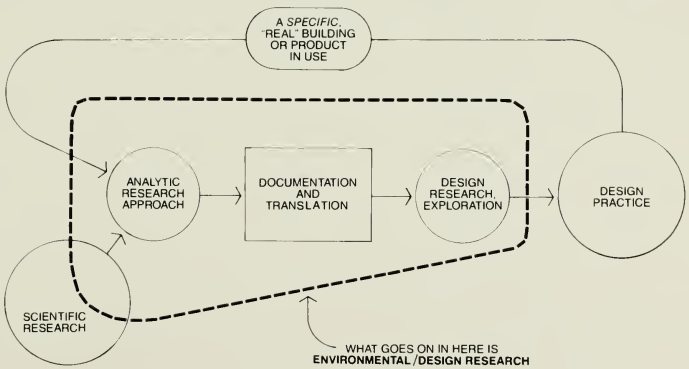
Within this context, values become a critical issue and environmental/design researchers feel that they must be stated explicitly, not because such researchers have a higher moral purpose, but because they bear a greater responsibility; the results of their work can profoundly affect how people live.

And often these users are unaware of the implications, coercion, and pervasiveness of design in their lives. Design is by nature implicitly value-laden; its stated purpose to seek excellence within constraints and "to improve" is a consistent objective. Science has always had two faces, that which strives for total objectivity and that which places emphasis on values. As the debate about genetic research illustrates, the moral issues surrounding scientific inquiry are becoming more critical. Researchers must always seek to balance the long term versus short term consequences of their work and to make "intertemporal" choices. An explicit statement of values makes such choices more understandable. As an emergent discipline, environmental/design research requires (if only ethically) a statement of assumptions, and opinions about its generalization and limitations.

4

Environmental/Design Research Model

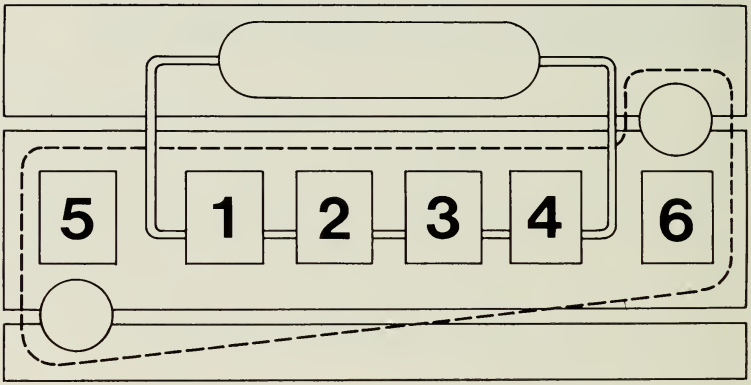
Below is a simple, descriptive model drawn to provide an image of environmental/design research and its relationship to design practice and scientific research. The model is intended to be useful as an hypothesis to test, rather than as an assertion. It describes a range of environmental/design research approaches, using both design and science as a medium. It also tries to set some boundaries, so we may start to define what is not environmental/design research.



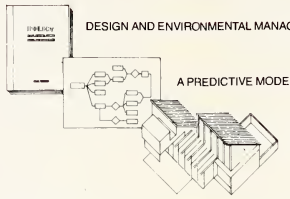
The model is methodologically, not topically based. Virtually any topic may be studied within it that relates people, the designed environment and changes in the quality of life that result from the two converging. This constraint necessarily excludes most research where improvement of a specific technology is an end in itself and where the human, qualitative implications are secondary or beyond the scope of the work. Excluded

for this paper's definition of environmental/design research, depending on how their hypotheses are framed, would be research projects focusing on the mechanics and materials of building, computer hardware research; research about design organizations and professional activities; and research primarily for marketing or stylistic purposes.

More examples of research that may or may not be included in the model will be given later. Areas of research that are "excluded" may themselves be very important concerns and deserving of support, but they fall outside of this particular definition. The more detailed model shown on the opposite page helps to further describe these boundaries.



THE NATURAL ENVIRONMENT, BUILDINGS AND DESIGNED SPACES, FURNITURE, EQUIPMENT AND PRODUCTS *IN USE* AND POLICIES AND PREDICTIVE MODELS *IN USE*...AVAILABLE FOR EVALUATION



DESIGN AND ENVIRONMENTAL MANAGEMENT POLICY

A PREDICTIVE MODEL OF A DESIGN IN USE

A SELECTED DESIGN, BUILT, USING REAL WORLD CRITERIA, AND USED.

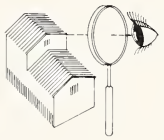
DESIGN PRACTICE/APPLICATION

A DESIGN PARADIGM FOR DESIGN RESEARCH

DEVELOPMENT OF THEORIES/METHODS FOR EVALUATING THE IMPACT OF NATURAL AND MAN-MADE OBJECTS AND ENVIRONMENTS ON PEOPLE

A PRODUCT BY ITSELF

EVALUATION OF THE IMPACT OF NATURAL AND MAN-MADE OBJECTS AND ENVIRONMENTS ON PEOPLE OR A PREDICTIVE MODEL OF ANY OF THESE



DOCUMENTED FINDINGS OF EVALUATION RESEARCH

A PRODUCT BY ITSELF

TRANSLATION OF EVALUATION RESULTS INTO DESIGN, MANAGEMENT AND POLICY CRITERIA WHICH AFFECT PEOPLE

A PRODUCT BY ITSELF

GENERATION AND ANALYSIS OF ALTERNATIVE DESIGNS USING RESEARCH CRITERIA AND/OR SYSTEMATIC METHODS AND DEVELOPMENT OF FORMAL IMPLICATIONS

A PRODUCT BY ITSELF

DEVELOPMENT OF THEORIES/METHODS FOR GENERATION OF AND SELECTION FROM, DESIGN ALTERNATIVES WHICH ARE RESEARCH CRITERIA BASED

A PRODUCT BY ITSELF

ENVIRONMENTAL/DESIGN RESEARCH

A SCIENTIFIC PARADIGM FOR DESIGN RESEARCH

SCIENTIFIC RESEARCH/PURE SCIENCE

Model Graphics by Lance Brown of Brown and Bee, Architects and Urban Designers.

This more detailed model suggests a number of linear relationships characterizing the spectrum of environmental/design research approaches, with a more or less scientific approach on the left, moving towards a more design-oriented approach on the right. Just outside the boundaries of environmental design research are pure science below and traditional design practice above. The linear aspect of the model should not imply that an environmental/design research project must encompass all six steps. Few projects will. Nor is sequence necessarily implied.

Legitimate products of environmental/design research can occur at all points in the model and fully useful and complete products may be produced at several points.

(These products are indicated on the model. In addition, a key for text references to the model is on p. 22.)

Therefore, an environmental/design research project can be accomplished wholly on the "scientific" end of the methodological spectrum (done at point #1 on the model and documented at point #2), or wholly on the design end, with the testing of specific research criteria and the development of specific formal implications at point #4. Results can be presented as evaluation research conclusions (point #2) or they may be translated into the specific vocabulary of the user as policy, management, or design criteria (point #3), or they may be presented as form itself.

The model also includes the development of theories, methods, models and procedures (point #5) for evaluating the impact of natural phenomena and design objects and environment and, at point #6, for generating and evaluating form in response to specific research criteria. Here may also be included research into design/planning methods and processes to develop the information necessary to solve a problem economically, elegantly, systematically, and ethically.

The products of environmental/design research, which are produced at a number of points, can be used to produce design and environmental management pol-

icy, predictive models of designed environments as if they were in use and, of course, designs for buildings, places and objects for social purposes. These are the major applications of the research. The products of these applications can then become subjects for evaluation and research closing a broad feedback loop.

The research model ranges from more traditional scientific approaches to environmental/design research, on the left, to design methodologies, policies and predictive models on the right.

Within a research mode, the right side of the model (design as a test of research hypotheses or other research-related criteria) is perhaps less well understood and less well-developed in theory and method than the left. The more conventionally scientific, or left, end of the model is primarily analytical, where the whole is frequently (although not necessarily) broken down into constituent parts in order to increase understanding. This approach begins with the analysis of places in use (or predictive models or policies) and ends, usually, with results expressed in words, formulae, and diagrams.

The right side of the methodological spectrum describes a synthetic approach to research, where the process of design becomes a research methodology under controlled circumstances. The design mode of research may actually result in physical form, although it may also result in predictive models, theory, or policy. Whereas the scientific paradigm was primarily analytical, the design paradigm uses form as a medium to synthesize, in some cases, results greater than the sum of its parts. Its purpose is to explore and test the formal implications of specific research-based criteria by a replicable process, to develop a theoretical and methodological basis for design, and to explore their perceptual and formal implications and relationships.

Design itself can thus be used as a method for environmental/design research projects. When so used, the number of variables it deals with are fewer than in conventional practice, and carefully selected to support

the research plan. Likewise, the constraints brought to design-within-research are more artificial than in conventional practice. An example of such use would be to use building designs as "subjects," with designers using their normative design process, but controlling program or other variables in systematic ways. In this way, the design process can be translated into a learning process, combining both theory and practice for evaluation.

The results of research include information useful to design, management, policy, and research itself, but they are usually presented in the language of persons doing the research and thus more suitable for other researchers than for the users of research. Documentation of research results for peer use and evaluation is a traditional and valued mode of communication for researchers. However, since the products of environmental/design research are varied, can occur at many points, and can be applied directly to policy, model development and design, research results always require translation into a forum or medium that facilitates its use and application. Designers, in particular, learn about and use information in a different way than most researchers present it, with the result that important environmental/design research is frequently not used, or is used poorly, or is used wrongly by designers.

Information is a term implying usefulness; if the purpose of the research is to generate information, the presentation of results in useable form is critical.

In some cases, translation may only require a change in the medium or mode of presentation. In other cases, more substantive work may be involved in making research results meaningful to a specific user group, including the further development of specific aspects of the research itself. The translation process can itself be an area of research concern and may be focused at any point in the process where a result can be applied as policy development, modeling, or design.

5

Frameworks for Environmental/Design Research

Some illustrations of what may and may not be considered environmental/design research by this paper's criteria will serve to clarify its concepts and concerns.

1. Environmental/design research can be distinguished from other kinds of related research by the requirement that it emphasize the relationship between people and the designed environment, and its implications for the quality of life.

If, for example, it is proposed to analyze the seismic resistance of alternative structural systems for buildings in order to develop guidelines for their use, this would not fall under environmental/design research as here defined, but under building or construction research. If, on the other hand, it is proposed to study the cognitive images people have of the stability of various kinds of structures, this would qualify as environmental/design research. So would research that examines human responses to building sway and vibration as a criteria for advancing the state of the art of sway damping system design. The process of selecting a structural system for a particular building, however, is not environmental design research; it is an element of design practice.

Another example can be drawn from the area of industrial design. If it is proposed to develop a new chair

to complete a line of office furniture, this is an application of market research and not environmental/design research as here defined. The development and testing of new concepts of seating that assure health and comfort over prolonged periods of time, however, could be an environmental/design research project.

Research about design practice may or may not be considered environmental/design research, depending on how it is framed. A project to survey liability suits over the past ten years would not be environmental/design research. But a project to test the hypothesis that concern about liability has made design practice conservative and inhibited innovation could be developed as an environmental/design research project and might include the survey of liability suits mentioned earlier. In this case, however, the survey would be a tool in developing a broader theory of design and not an end.

As the previous example illustrates, environmental/design research need not deal with a physical product, and might likely deal with the development of theory, methods, and models relating to policy, management, organization, evaluation, or process.

2. Environmental/design research can be distinguished from design practice, although good design practice will effect its integration into the design process.

A project that seeks to make a learning system out of the design process may be considered environmental/design research if it is based on systematic and replicable criteria capable of being evaluated. In this case, the practice of design becomes an element of the research design, and the purposes of the research are related to intervention, innovation, and evaluation strategies consistent with the objectives of design practice. An example would be the development of strategies to minimize vandalism in a large-scale building program, where the results of the research would be integrated into the design process of specific facilities as criteria that would inform and modify the design process over time.

Environmental designers, in fact, often include a systems analysis of institutions, decision procedures, mandates

and constraints in order to design products that fit or alter that process to fit products with which it normally doesn't deal.

In the case of environmental/design research relating to physical products, the following example may be useful in distinguishing design practice from research proposals. If an architectural firm were to propose research about natural light for a particular project, this would not be an adequate description of an environmental/design research as here defined. Although the effort might include a literature search, training in appropriate techniques, and site visits to similar projects to expand the firm's knowledge base, its purpose is to apply, not generate knowledge. There is no research design; the results are directed to a single building and firm and not the generic advancement of the field.

If, on the other hand, it was proposed that natural light, with its variable quality and implied connection to the outdoors, could improve productivity and job satisfaction, and that research was needed to test this hypothesis and to develop its formal implications, this could be considered an area of environmental/design research.

3. Environmental/design research can deal with the art as well as the science of design.

Environmental/design research strives to generate knowledge useful to design and design policy in order to improve the quality of life. This raises issues about some of the inquiries relating specifically to the art of design and, more specifically, the role of formalist controversies within architecture today. The ultimate purpose of art may be described in such qualitative terms as raising the levels of human aspirations, spirit and perceptions and thus improving our lives. Does it follow then that an inquiry into the artistic elements of architecture is therefore environmental/design research? For purposes of this paper, the answer is that these concerns can indeed be structured into such a research project and that aesthetic theory may be a legitimate topic for research.

Where the art of place-making, broadly defined, and the generation of knowledge are concerns for research, the research must exhibit clear, systematic, and doc-

umented procedures. This does not mean that the design process itself must be wholly rationalized to exclude intuition (however defined), but that the research design, or framework for inquiry, must be rational and explicit. Within this structure, the following example provides clarification.

If it is proposed to do research about all the kinds of windows used in architecture through the ages and to develop a visual typology of forms from them, this would not be considered environmental/design research within the framework of this paper. This kind of inquiry, although potentially very useful, does not generate, but rather catalogs, information; there is no research design or hypothesis and no objective proof. It also does not include, as a concern, the human factors or uses associated with windows. If on the other hand, one proposes doing research to test the hypothesis that certain window designs have cultural and functional associations that provide building users with a sense of security, function and delight that can compensate for other economies of building design, this could be structured as an environmental/design research project. In order to do the work, it might be necessary to develop a typology of window designs as a basis for determining the design criteria that have the desired impacts and to develop new criteria for window design, but such a typology is part of the research methodology and not the objective of the research.

In another example, an environmental/design research project might investigate the concept of symmetry as it inheres in nature — its contours perceived by man — and use this as a basis for developing a mathematically-based aesthetic of the environment and the beautiful. In this case, part of the work would be to systematically test and translate such highly abstract concepts as left-right opposition, balance, centering, inversion, and the symmetries of expansion, progression and duplication into a basis for evaluating and generating modern form with specified perceptual connotations. Yet as always, the research design, including methods and procedures, should be replicable and the validity of the conclusions demonstrable.

4. Environmental/design research includes basic, as well as applied, research.

Basic research, unlike applied research, cannot be justified on the basis of specific problem-solving; its application may be unknown. Its primary justification is the generation of knowledge and the discovery of phenomena, processes and systems that are potentially significant to the quality, function, process, organization and theory of design.

It does not follow, however, that basic research is vague in conception or that it lacks structure in its development, procedures and validation. Examples of basic research in environmental/design research include the hypothesis that the quality of life can be enhanced by design that exhibits differentiation by orientation in response to the daily and seasonal migrations of the sun, similar to natural structures. Such measures as urban legibility, variety and richness of form, and human and energy performance may be considered. The concept of rhythmical time as a basis for form generation may be explored and tested. In this case, the research would include investigations into the movements of the sun and time descriptors of the natural and built environment and would explore the relationship of these criteria to the generation and evaluation of designed form. The value of this work is potentially significant; it may result in new criteria for urban and building design, or increased comfort, choice, performance and satisfaction, but the original objective is the generation of new knowledge about relationships, cyclic time, aesthetic theory and form.

Another example, may be a project investigating the concept of "minimum inventory/maximum-diversity" systems, starting with observations from nature (all snowflakes are regular hexagons, but none are alike) as a basis for design theory and the systematic generation of new forms.

Frequently, the evaluation of such projects must be qualitative as well as quantitative. By definition, the ideas being researched are in the exploratory stage. But the research proposal can be evaluated on the basis of the

elegance of the ideas and the systematic nature of the approach.

However qualitative the subject of the research (and, in some cases it may be highly precise and quantitative), the research design itself must include the capability of objective evaluation and replicability; as research it must withstand evaluation of method, proof and result.